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Apply Pesticides Correctly. A Guide for Commercial Applicators. Public Health Pest Control

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APPLY PESTICIDES CORRECTLY
A GUIDE FOR COMMERCIAL APPLICATORS

PUBLIC HEALTH PEST CONTROL

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDE PROGRAMS
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PREFACE

Federal regulations establish general and specific standards that you must meet before you can use certain pesticides. Your State will provide material which you may study to help you meet the *general* standards.

This guide contains information you must know to meet the *specific* national standards for applicators who are engaged in public health pest and vector control. Because the guide was prepared to cover the entire nation, some information important to your State may not be included. The State agency in charge of your training can provide the other materials you should study.

This guide will give you information about major pests and vectors important to public health, including:

- recognition of pests and vectors,
- their life cycles and habitats,
- a knowledge of disease transmission,
- methods you can use to control pests and vectors without pesticides,
- using pesticides in combination with other methods, and
- the effect of pest control on the environment.

INTRODUCTION

PUBLIC HEALTH PEST CONTROL

Public health pests are animals which:

- are involved in the transmission cycle of disease agents (pathogens) that affect humans,
- injure humans by biting or stinging,
- cause internal and external parasitism (myiasis), and
- cause annoyance or discomfort.

Most public health pests are insects. There are others, such as:

- mites, ticks, and spiders, and
- vertebrates.

The transmission of pathogens involves:

- a virus, rickettsia, bacterium, fungus, or protozoan,
- reservoir (the animal where the pathogen occurs in nature),
- vector (the animal that transmits the pathogen from the reservoir to man),
- host (the animal on which the pest or vector feeds).

In some instances you should work with a physician or a veterinarian to control public health pests. Your State Health Agency, your State Pesticide Regulatory Agency, or your Cooperative Extension Service can advise you.

GENERAL TECHNIQUES OF MANAGING PUBLIC HEALTH PESTS

Effective control of public health pests is usually accomplished by one or more of the following:

- sanitation—removing a pest's source of food and shelter; for example, trash and garbage where rats live and feed;
- habitat disruption—for example, draining areas where mosquitoes breed;
- biological control—such as introducing mosquito-eating fish into aquatic areas;
- mechanical control—designing and maintaining buildings and other structures to physically exclude public health pests such as flies, mosquitos, and rats;
- personal protection—wearing long-sleeved shirts, long trousers, and using repellents;
- suppression—use of pesticides or mechanical devices, such as traps, to reduce pest populations.

INSECTS

COCKROACHES

Cockroaches:

- destroy and contaminate food and other materials,
- produce a disagreeable odor when numerous, and
- are repulsive.

Cockroaches are oval and flat-bodied. A shieldlike covering extends over the head. Adults, depending upon the species, are from ½ to 2 inches long.

The stages in the life cycle of a cockroach are:

- the egg, enclosed in a capsule which contains several eggs,
- several stages of nymphs, which resemble the adults except that they are smaller and have no wings, and
- the adult.

The entire life cycle may require 6 months to 2 years.

Cockroaches:

- are active in the dark, preferring to hide when it is light,
- usually prefer warm, moist places,
- are scavengers and will eat almost any food.

The four most common species in the United States are the:

- German cockroach, which may enter houses with packages and bags of food. It prefers kitchens, and is often found near plumbing fixtures and heating ducts. This is the most common species in restaurants. Adults are about ½ inch long and tan to grayish in color.
- American cockroach, a large insect found in alleys, sewage systems, basements, and other warm, moist places. Adults are up to 2 inches long and are generally reddish-brown.

- Oriental cockroach, usually found outdoors, but may come indoors during dry, cold weather. Adults are about 1 inch long and are black. Wings are much shorter than abdomen. Females are wingless.
- Brownbanded cockroach, which prefers drier areas indoors, so may be found throughout a building. Adults are about 1 inch long. They are brown with two lighter bands across the abdomen.

NONCHEMICAL CONTROL includes:
- sanitation and good housekeeping to eliminate food and harborage, and
- close-fitting doors and screens to prevent entry.

CHEMICAL CONTROL includes:
- applying residuals or space sprays, usually with a hand sprayer, or
- using baits.

Be careful to observe all label directions when using pesticides in food-handling areas.

SUCKING LICE

Louse bites cause severe itching. Scratching the bites can lead to secondary infections. The body louse also may transmit diseases.

The stages in the life cycle of a louse are:
- the egg or nit,
- three nymphal stages, and
- the adult.

The entire life cycle may be completed in a month.

The sucking lice that affect people are the:
- head louse,
- body louse, and
- crab louse.

The head louse:
- attaches its nits to the hair close to the scalp. As the hair grows, the nit moves away from the scalp. An active infestation is indicated by nits within ½ inch of the scalp.
- nymphs and adults are found primarily in the hair close to the scalp, most often around the ears and nape of the neck. Sometimes they may be found in hats, combs, brushes, or upholstered furniture.
- is transferred between people who share the same bed, headgear, clothes rack, or combs and brushes.

When looking for head lice, examine suspected nits under magnification. Hair sheaths and droplets of hair spray may resemble nits.

The body louse:
- attaches its nits to fibers of clothing or to body hairs, including pubic hairs,
- moves out of the clothing to feed, then returns to hide in the seams,
- is acquired by physical contact or when one shares the clothing or bedding of an infested person.

The crab louse:
- attaches its nits to the coarse pubic hairs and hairs around the anus, infrequently to other body hairs,
- remains on the body, usually in the pubic area,
- is transferred by direct contact (usually sexual) or by means of toilet seats or beds.

Body Louse and Head Louse

Crab Louse

NONCHEMICAL CONTROL includes:
- drycleaning or laundering headgear, clothing, and bedding to control body lice.

Control of lice should be carried out in consultation with a physician. It will be most effective if all persons involved in the infestation (a family, a school class) are examined and, if necessary, treated.

CHEMICAL CONTROL:
- includes using pesticides that kill lice. These are available as shampoos, lotions, emulsions, or dusts.
- may be complicated by resistance to the pesticide.

FLEAS

Fleas affect people by:

- bloodsucking, which causes skin irritation,
- transmitting the pathogens that cause bubonic plague and murine typhus.

The most common species bothering people in houses are the cat flea and the dog flea. Fleas are wingless, laterally-compressed insects from $\frac{1}{25}$ to $\frac{1}{3}$ inch long. The legs are adapted for jumping.

The stages in the life cycle of a flea are:

- the egg, laid loosely on the host or in its nest,
- several larval stages, which feed upon organic matter found in the nest of the host,
- the pupa, which spins a silken cocoon incorporating bits of debris from its surroundings, and
- the adult, which in most species lives in the nest or burrow and jumps onto the host to feed. Adults can live for several weeks without food, but must have blood to produce eggs.

Flea

NONCHEMICAL CONTROL includes:

- sanitation, such as cleaning and vacuuming cat and dog quarters,
- excluding wild-animal hosts from attics, wall voids, basements, and crawl spaces.

CHEMICAL CONTROL may include:

- applying insecticides as crack and crevice treatments, or
- use of flea collars.

BED BUGS

The bed bug, primarily a pest of man:

- sucks blood, sometimes causing severe reactions,
- produces a disagreeable odor, and
- is repulsive.

The bed bug is a wingless, flat, reddish-brown insect about ¼ inch long. Similar bugs, normally pests of bats or birds, may bite people when their usual hosts are absent.

The stages in the life cycle of a bed bug are:

- the egg, glued inside cracks and crevices,
- several stages of nymphs (these resemble the adult, but are smaller and require a blood meal for each molt), and
- the adult.

Bed bugs avoid light by hiding in mattress seams and tufts, bedframes, in cracks and crevices, under wallpaper, and in similar places. They feed in the dark. The life cycle may require from 1 to 5 months. All stages can survive starvation for several months.

Bedbug

NONCHEMICAL CONTROL includes:

- using a mattress sterilizer, and
- removing bird nests which touch houses, and
- preventing the entry of bats.

CHEMICAL CONTROL consists of:

- applying insecticides to the hiding places. Use a pin nozzle for cracks and crevices and a fan or cone nozzle for the mattress. Make sure the mattress is dry before it is used again.

BEES, WASPS, HORNETS, AND YELLOW JACKETS

The stings of bees, wasps, hornets, and yellow jackets:

- cause pain and swelling, and
- sometimes result in a severe allergic reaction, which may cause serious illness or even death.

These insects have similar life cycles including the egg, several larval stages, pupa, and adult.

Their habitats differ:

- Honey bees are usually domesticated in hives, but also may establish themselves in attics, wall voids, or hollow trees.
- Bumblebees and yellow jackets nest in the ground.
- Hornets build large paper nests above the ground.
- Wasps (depending upon the species) build mud nests, build paper nests in sheltered places and under eaves, or dig holes in the ground.

NONCHEMICAL CONTROL includes:

- trapping, and
- exclusion (screens).

CHEMICAL CONTROL: Special pesticide formulations are available for control of these insects. They may be used:

- for treating the nest when the insects are inactive (either early in the morning or after dark), or
- as poisoned baits, which yellow jackets carry back to their nest, thereby killing the larvae.

Many of these insects are highly beneficial as pollinators and predators. They should be controlled only if they are a threat to people.

MOSQUITOES

Mosquitoes are bloodfeeding pests of birds and animals, including man. They can lower property values and reduce weight gain in animals.

They transmit diseases of man, including:

- several kinds of encephalitis, transmitted from mammal and bird reservoirs, and
- malaria, yellow fever, and dengue fever, presently very uncommon in the United States.

Mosquitoes are two-winged insects ⅛ to ½ inch long. All have scales on the wing veins and fringes and have relatively long legs.

The stages in the life cycle of a mosquito are:

- the egg, which may be laid on water or in areas which will later be flooded, depending upon the species,
- four larval stages, found only in water, which feed upon microorganisms and other organic matter,
- the pupa, aquatic and motile but nonfeeding, and
- the adult.

After mating, the female of most species seeks a blood meal in order to produce viable eggs. The male takes only plant juices, never blood.

Mosquito life cycles fall into two general types:

- Permanent-water mosquitoes develop in water which stands for relatively long periods. The females lay the eggs on water, either singly or in masses. Most of these mosquitoes overwinter as adult females.
- Flood-water mosquitoes develop in water present only intermittently. The females deposit eggs on damp soil, debris, or plants, not water. The eggs are resistant to drying and survive months or even years until they are covered with water. At that time, the larvae hatch and development continues. Most of these mosquitoes overwinter as eggs.

MOSQUITO SURVEILLANCE, a vital preliminary step to control, involves:

- collecting and identifying adults and larvae to confirm the existence and source of the problem, evaluate its importance, and help choose a control method. You will need special equipment, such as traps, dippers, eyedroppers, and a microscope.
- recording and analyzing information about kinds, numbers, and location of mosquito adults and larvae; weather; and other factors (rainfall, temperature, tide tables, irrigation cycles) that contribute to mosquito production.

The goal of mosquito control is to maintain mosquito numbers at a low level so that they neither transmit disease nor annoy people.

MECHANICAL-PHYSICAL CONTROL includes:

- excluding mosquitoes from structures by using screens on doors and windows, and
- altering the environment so that the mosquitoes cannot complete their life cycle. This can be done by:
  - —managing land and water by grading and leveling, ditching, and draining so that water does not stand long enough for larvae to develop,
  - —fluctuating water levels to strand larvae and harborage,
  - —installing dikes and gates to keep salt marshes flooded so that salt marsh mosquitoes cannot lay eggs,

—draining, filling, or disposing of unnecessary water-holding containers such as auto tires, and
—designing and maintaining necessary water-holding structures (such as impoundments, water treatment facilities, and irrigation and drainage systems) to eliminate or minimize their potential as mosquito sources.

These measures can affect organisms other than mosquitoes. In addition, they may affect the use of the water for such things as wildlife, recreation, and power. You must determine whether physical control work would cause unreasonable adverse effects.

BIOLOGICAL CONTROL includes:
- introducing mosquito-eating fish into permanent or semi-permanent water. You must be sure that your State wildlife agency permits such introductions. You can increase the effectiveness of fish or other natural predators by eliminating harborage for mosquito larvae.

CHEMICAL CONTROL includes the use of:
- repellents, which provide personal protection when applied to the body.
- larvicides, which kill the developing mosquitoes before they leave the water. Proprietary and petroleum fuel oils, organophosphates, plant-derived chemicals, and synthetic growth inhibitors of mosquito larvae are available as larvicides. They are formulated as solutions, emulsions, and granules (seldom wettable powders) for application to the aquatic habitat by air, power, or hand equipment. Consider accessibility of the area and ground cover when selecting the application method and formulation to use. Susceptibility to certain pesticides by larvae (depending upon species) will determine which pesticide to use.
- adulticides, which kill adult mosquitoes. Several plant-derived and synthetic pesticides are available as liquid and dust formulations for aerial, ground, power, or hand equipment application. These include pyrethrums, organophosphates, carbamates, organothiocyanates, and synthetic pyrethroids. Some adulticides are used to kill mosquitoes that alight on treated surfaces. Most adulticides are aerosols, which are pesticides applied as fogs (sometimes vapors or fine dusts) that contact and kill the mosquitoes. Fogs consist of very small droplets suspended in the air that contact adults flying in the area. Suspended droplets remain close to the ground and penetrate grass and vegetation screens. Small droplet size is obtained through the use of aerosol or ultra low volume application equipment. Drift can be a problem with fogs.
- herbicides, which kill plants that harbor mosquito larvae or adults.

MIDGES

Biting midges:
- are also called punkies, sandflies, or no-see-ums;
- are tiny two-winged insects;
- severely annoy people by bloodsucking;
- have a body usually less than $\frac{1}{16}$ inch long.

The stages in the life cycle of a biting midge are:
- the egg, laid in salt marshes, mud around freshwater ponds, in soil cracks, or highly organic water, depending upon the species,
- several larval stages, worm-like and slow in developing.
- the pupa. and
- the adult.

There is usually only one generation per year.

CONTROL METHODS include:
- applying adulticides with aerial or ground equipment,
- using repellents, and
- using very fine mesh screens. Ordinary window screens will not keep midges out.

There are also some nonbiting midges which cause annoyance when they are very abundant.

BITING FLIES

Bitting flies are bloodsucking pests which can cause problems in local areas. They include:
- blackflies,
- horse and deer flies, and
- stable flies.

The stages in the life cycle of biting flies are:
- egg,
- several larval stages,
- pupa, and
- adult.

CHEMICAL CONTROL includes the use of:
- adulticides,
- larvicides for blackflies, and
- repellents for personal protection.

EYE GNATS

Eye gnats annoy people by persistently flying around the face.

CONTROL may be achieved by:
- nontillage of agricultural breeding grounds,
- applying suitable larvicides,
- using traps or poison baits to control the adults,
- using repellents for personal protection.

DOMESTIC FLIES

Domestic flies are those that live in close association with people. The most common are:
- housefly,
- little housefly,
- face fly,
- vinegar flies or fruit flies,
- blow flies or bottle flies, and
- flesh flies.

Flies are not only annoying insects. but also are involved in human diseases, including:
- mechanically transmitting the pathogens that cause typhoid, dysentery, and other diseases of the digestive system,
- myiasis, which is the condition caused by fly larvae living upon or within the body.

These flies are two-winged insects, ranging from 1/10 to ½ inch in length, depending upon species. Most are about ¼ inch long. The stages in the life cycle of a domestic fly are:
- the egg (deposited in a moist place),
- several stages of larvae (maggots),
- a pupa, and
- adult.

In most species, the larva crawls to a drier location to pupate. The life cycle typically requires 2 to 3 weeks, but can be as short as 1 or as long as 6 weeks, depending upon the species and conditions.

The domestic fly develops in many types of moist organic matter, including:
- animal manure,
- garbage,
- decaying plant and animal material,
- fruit and vegetable culls and wastes.

CONTROL is based upon sanitation. This includes:
- collecting garbage twice a week in residential areas so that flies cannot emerge.
- disposing of garbage to prevent fly production. Incinerators may be allowed if they do not cause air pollution. Sanitary landfills are widely used. Each day's deposits must be covered, then the earth compacted.
- managing manures by appropriate cleanout, drying, or other means, to prevent fly emergence.
- properly disposing of fruit and vegetable culls and dead animals.
- sanitary treatment and disposal of liquid wastes and sludge.

NONCHEMICAL CONTROL includes:
- screening doors and windows and keeping them shut,
- air barriers—fans that produce air currents which prevent flies from entering openings impractical to screen,
- introducing predators and parasites. This is especially effective for reducing the number of flies produced in poultry manure.

CHEMICAL CONTROL:
- can be a useful supplement to sanitation.
- may be hampered by resistance, especially to residual insecticides.
- may include the use of baits.
- is difficult to attain with larvicides, which may kill fly predators and parasites.

MITES, TICKS, AND SPIDERS

MITES

Several species of mites cause skin irritation by biting man (chiggers), burrowing into the skin (scabies mite), or crawling over the skin (pigeon mites, grain mites). Mites on birds or rodents may invade houses and bite people if their normal hosts leave or die. Most species are barely visible to the unaided eye.

The stages in the life cycle of a mite are:
- the egg,
- the six-legged larva (chiggers are larvae of certain species),

- several stages of nymphs, and
- adult.

In most species the life cycle is completed in less than 4 weeks.

CONTROL:
- of chiggers may be achieved by keeping grass cut in public areas, or spot-treating with acaricides.
- of species infesting the human body must be guided by a physician.
- includes use of repellents for personal protection.

TICKS

Diseases transmitted by ticks include:
- Rocky Mountain spotted fever, caused by a rickettsia,
- tularemia, caused by bacteria, and
- Colorado tick fever, caused by a virus.

Tick paralysis is caused not by a pathogen, but by tick bites around the head or neck.

The stages in the life cycle of a tick are:
- egg,
- six-legged larva,
- nymph (or nymphs), and
- adult.

The life cycle may take 2 or 3 years, depending upon the species of tick and the availability of hosts.

CONTROL includes:
- inspecting oneself and removing ticks,
- clearing brush and cutting weeds to remove habitat of ticks and their rodent hosts.

If illness develops after a tick bite, consult a physician.

SPIDERS

Two kinds of spiders cause injury to man:
- black widow spiders. A bite may cause severe pain. The bite is rarely fatal. The female black widow spider has a red hourglass-shaped pattern on the underside of its shiny, black, round abdomen.
- brown recluse (fiddleback) spiders. A bite may result in pain, followed by death of flesh around the bite. Brown recluse spiders have a dark, violin-shaped pattern on the top of the fused head and thorax on a yellow to brown body.

Many other species look fearsome, but are harmless. A spider develops from an egg into an immature spider which may molt several times before becoming an adult.

CONTROL:
- can be accomplished by applying pesticides to the places where spiders build their webs and hide.

VERTEBRATES

DOMESTIC RODENTS

The term "domestic rodents" includes:
- Norway rats,
- roof rats, and
- house mice.

Rats and mice not only cause severe economic damage, but also damage structures, contaminate food and feed, and bite man. They are reservoirs for several diseases.

All three domestic rodents have:
- a well-developed sense of touch in their whiskers and guard hairs. They prefer to run where they can keep these sensors in contact with side surfaces.
- good eyesight—readily detect motion, but are color blind,
- a keen sense of smell, but are not repelled by the smell of man,
- a discriminating sense of taste,
- keen hearing (try to escape from unusual noises),
- excellent balance,
- good climbing ability, and
- good swimming ability, even through drains and toilet-bowl traps.

Domestic rodents are nocturnal and rarely appear during the day. However, they leave characteristic signs which make it possible to tell what species are present and whether an infestation is current or old, heavy or light.

These signs include:

- droppings, which are moist, soft, shiny, and dark when fresh, but become dry and hard in a few days. They are dull, grayish and easily crumbled when old.
- outdoor runways, which are narrow pathways swept clear of debris. Indoors, they are greasy paths along walls, steps, and rafters (cobwebs and dust indicate an unused runway).
- rubmarks, which are dark greasy marks along the sides of regularly traveled runways. Fresh marks are soft and will smear if rubbed, while old marks are dusty and will flake off if scratched. Rats leave rubmarks along runways at or near ground level (usually the Norway rat), and leave swing marks overhead where beams or rafters connect to a wall (usually the roof rat). Mice do not leave rubmarks unless the infestation is heavy.
- burrows, used commonly by Norway rats and house mice for nesting and harborage, only occasionally by roof rats. Fresh burrow entrances are free of cobwebs and dust and may show rubmarks. There may also be fresh earth or food fragments near the openings.
- tooth marks caused by daily gnawing which keeps the incisors short enough to use. Fresh gnawings in wood are lighter in color and show distinct teeth marks, while aged gnawings are darker and become smoothed.
- tracks, sharp and distinct when fresh but dusty and less distinct when old. Smooth patches of dust (flour, talc) may be placed along runways and checked for recent activity by holding a flashlight at a low angle so the tracks cast shadows. Tail marks may also be seen.

The **Norway rat:**

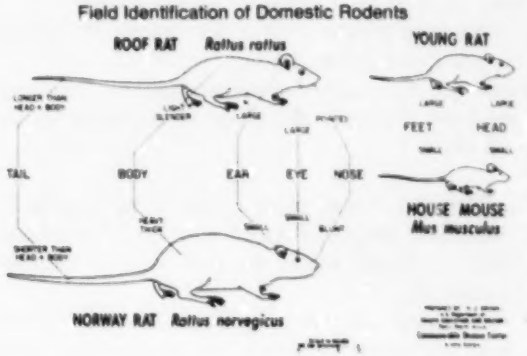
- lives outdoors in any protected place which is near the ground, close to food and moisture.
- lives indoors between floors and walls, in enclosed spaces of cabinets, shelving, and appliances, in rubbish, and in any other concealed place.
- has an average feeding range of 100–200 feet in an urban area, more in a rural situation.
- requires ¾ to 1 ounce of dry food, and ½ to 1 ounce of water each day.

The **roof rat:**

- lives outdoors in any protected place above the ground near food and moisture.
- lives indoors in attics, between walls, and in enclosed spaces of cabinets and shelving.
- has an average feeding range of 100–200 feet, sometimes more.
- requires ½ to 1 ounce of dry food, and up to 1 ounce of water each day.

The **house mouse:**

- lives in any convenient protected space inside or outside.
- has an average feeding range of 10–30 feet.
- requires $^{1}/_{10}$ ounce of dry food and $^{3}/_{100}$ ounce of water each day.



Successful rodent control depends upon controlling entire rodent populations. A population may be the rodents within a city block, sewer, farm, feed mill, or smaller area.

NONCHEMICAL CONTROL of rodents includes:

- managing refuse so that it will not provide food and harborage to rodents. It should be stored in leakproof containers and either recycled or disposed of at a sanitary landfill.
- storing usable materials so that food and harborare are at a minimum. Packaged bulk foodstuffs should be 12 to 18 inches off the floor and away from the wall. Keep food from opened packages in closed glass or metal containers. Sweep floors clean to reduce food for rodents and to aid in detecting fresh rodent signs. A 6-inch-wide white band painted on the floor along the wall of food-handling establishments will make fresh rodent signs more visible.
- modifying existing buildings or designing new buildings to keep rodents out. Doors, windows, and other openings must fit snugly (less than ¼-inch clearance) and be equipped with metal or concrete barriers. Eliminate dead spaces such as double walls, floors, or other enclosed areas.

- trapping, useful when poisons fail or would be too risky, when the odor of poisoned carcasses would be a problem, or (using live traps) when rodents must be captured alive to collect their blood and ectoparasites for disease studies.

CHEMICAL CONTROL can be accomplished by:
- fumigating burrows, or
- using poison baits, poisoned water, or
- poisoned tracking powders.

Types of baits most often used include the:
- single-dose poisons, which kill quickly if enough is consumed at one feeding, and
- multiple-dose poisons, which must be eaten repeatedly during a period of several days to be effective.

Considerations when using poisoned baits include:
- prebaiting (using untreated bait for several days before offering treated bait) to increase bait acacceptance,
- considering the rodent species and other food available when selecting the poison and bait,
- avoiding secondary poisoning by picking up rodent carcasses before dogs or cats find them,
- placing baits so that they will be eaten by rodents but not by other animals or people, and
- possible problems due to resistance or bait shyness.

BIRDS

Most species of birds are valuable and desirable members of the environment, but some are pests of man. Birds which are sometimes pests include pigeons, starlings, and English sparrows. Some birds contribute to the spread of encephalitis, caused by viruses and transmitted by mosquitoes from reservoir birds to man.

PEST BIRD CONTROL involves:
- sanitation to reduce sources of food,
- installing screens, barriers, and other devices to keep the birds away,
- trapping, shooting, or hand capture,
- using pesticides, which may be avicides, repellents, or chemosterilants. Poisons may kill desirable birds or may cause secondary poisoning in cats and other scavengers.

BATS

Bats are one of the most important mammals which are public health pests.

Bats affect man in these ways:
- Rabies is fairly common in bats, and people can get the disease when they handle or are bitten by an infected bat.
- Bat droppings can be a source of the fungus which causes histoplasmosis.
- Bat noise and odor can be annoying.

Bats feed upon insects. Some species roost singly, but most form colonies in caves, mines, or buildings. They have a low birth rate (usually only one offspring per year) but may live 20 years. Bats are generally beneficial. They should be controlled only if they pose a threat to public health.

BAT CONTROL can be accomplished by:
- bat-proofing buildings by closing openings where bats can enter. Eliminate openings larger than ¼ inch by covering them with hardware cloth or sheet metal, or plugging cracks with caulking or steel wool.
- using repellents or pesticides.
- fumigation.

If bats are controlled, you may need to watch for and control their ectoparasites.

A few other mammals transmit rabies or plague.

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15. Supplementary Notes
Apply Pesticides Correctly -- A Guide For Commercial Applicators -- Public Health Pest Control

16. Abstracts
This guide contains information for meeting the specific national standards for applicators who are engaged in public health pest and vector control. Because the guide was prepared to cover the entire nation, some information important to individual states may not be included. For additional information, contact the specific State training agency.

17. Key Words and Document Analysis. 17a. Descriptors

insects	midges	bats
cockroaches	biting flies	
sucking lice	eye gnats	
fleas	domestic flies	
bed bugs	mites	
bees	ticks	
wasps	spiders	
hornets	vertebrates	
yellow jackets	domestic rodents	
mosquitoes	birds	

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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